

# PATENT ABSTRACTS OF JAPAN

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(21)Application number : 08-094338 (71)Applicant : AISIN SEIKI CO LTD  
 (22)Date of filing : 16.04.1996 (72)Inventor : UMEMURA CHIAKI

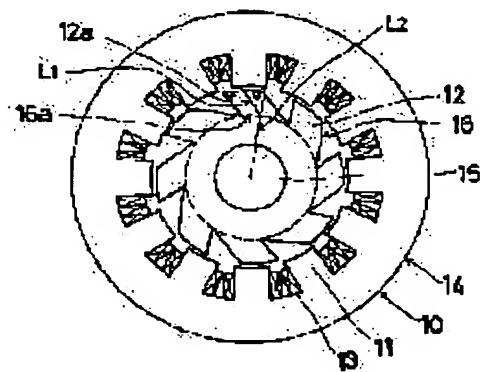
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## (54) SWITCHED RELUCTANCE MOTOR

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To increase the rotational torque of a rotor by sliding a straight line, connecting the center of the rotor surface in which the rotor faces to the stator with the center of the rotor base, by a given angle to the straight line going outward in diametrical direction from the center of the facing part.

**SOLUTION:** A rotor pole 12 is arranged so that a straight line L1 connecting the center of the rotor surface in which the rotor faces to the stator with the center of the base part 16a of a rotor 16 may be deviated by an angle  $\theta$  to the straight line L2 going outward in diametrical direction from the center of the facing part 12a. Hereby, in case that the direction of the circumferential component of this deviation and the rotational direction of the rotor 16 are the same, the rotational torque of the rotor 16 becomes large, and high torque can be obtained without increasing magnetic attraction.




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**CLAIMS**

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**[Claim(s)]**

[Claim 1] The stator of the shape of a ring which has two or more stator poles which project toward the inside, the coil wound around said stator pole, and the inner circumference of said stator -- said stator -- receiving -- the same axle and relativity -- it being arranged pivotable and with Rota which has two or more Rota poles which can form said stator pole and magnetic circuit The straight line which connects the core of the confrontation section which is a \*\*\*\*\* switched reluctance motor and meets said stator pole of said Rota pole, and the core of the fundus of said Rota The switched reluctance motor characterized by being shifted from the core of said confrontation section the degree of predetermined angle to the straight line which goes to the direction outside of a path.

[Claim 2] It is the switched RIRAKU lance motor characterized by having projected said stator pole toward the core of said Rota in the switched reluctance motor of claim 1.

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]**

[0001]

[Industrial Application] This invention relates especially to the running torque of a motor about the switched reluctance motor used for the source of power of an electric vehicle etc.

[0002]

[Description of the Prior Art] Conventionally, it is known as a source of power of an electric vehicle that a switched reluctance motor will use. An example of the switched reluctance motor 40 (SR motor is called hereafter) known conventionally is shown in drawing 5. The SR motor 40 has been arranged pivotable centering on a revolving shaft 45 inside the stator 44 of the shape of a ring which has the stator pole 41 where it has been arranged in the shape of a periphery, and the coil 43 was rolled, and a stator 44, and is equipped with Rota 46 which has the Rota pole 42 which counters the stator pole 41. the SR motor 40 -- the stator pole 41 -- 12 poles and the Rota pole 42 -- 8 -- it has very much. If the stator pole 41 and the Rota pole 42 are projected in the direction of a path toward the core of Rota 46, respectively and a current flows in a coil 43, Rota 46 will rotate by the Rota pole 42 which the stator pole 41 generates the magnetic-attraction force, and has it in the nearest location being attracted on the stator pole 41.

[0003]

[Problem(s) to be Solved by the Invention] However, since the stator pole 41 and the Rota pole 42 are projected in the direction of a path toward the core of Rota by the above-mentioned conventional SR motor, respectively, the magnetic-attraction force committed to the hand of cut in Rota 46 to the magnetic-attraction force committed in the direction of a path is small. Therefore, running torque of Rota 46 could not be effectively obtained to the magnetic-attraction force generated from a coil 43, but when the number of turns of a coil were increased in order to enlarge running torque of Rota, or the current passed in a coil was enlarged, there was a problem that the direction component of a path of the magnetic-attraction force will also increase, and the noise will also increase.

[0004] Then, this invention makes it a technical technical problem to increase the running torque of Rota, without increasing the number of turns of a coil or enlarging the current passed in a coil.

[0005]

[Means for Solving the Problem] The stator of the shape of a ring which has two or more stator poles where claim 1 projects toward the inside in order to solve the above-mentioned technical problem, the coil wound around a stator pole, and the inner circumference of a stator -- a stator -- receiving -- the same axle and relativity -- it being arranged pivotable and with Rota which has a stator pole and two or more Rota poles which can form a magnetic circuit It was made for the straight line which connects the core of the confrontation section and the core of the fundus of Rota which meet the stator pole of the Rota pole to be shifted from the core of the confrontation section the degree of predetermined angle in the \*\*\*\*\* switched reluctance motor to the straight line which goes to the direction outside of a path.

[0006] As opposed to the straight line in which the straight line which connects the core of the confrontation section of the Rota pole which meets a stator pole, and the core of the fundus of Rota according to claim 1 goes to the direction outside of a path from the core of the confrontation section the degree of predetermined angle by having made it shift When the component of the hoop direction of this gap and the hand of cut in Rota are the same directions, high torque can be acquired without the running torque of Rota becoming large and increasing the magnetic-attraction force compared with SR motor whose protrusion direction of the conventional Rota pole and a stator pole is the direction of a path.

[0007] Claim 2 had projected the stator pole toward the core of Rota in the switched reluctance motor of claim 1.

[0008] According to claim 2, a stator pole is made to project toward the core of Rota, i.e., it is having constituted, as only the Rota side's was shown in claim 1, a stator can increase the running torque of Rota further, it is the same configuration as the conventional SR motor, and can acquire high torque further, without increasing the magnetic-attraction force.

[0009]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Drawing 1 is the sectional view of the SR motor 10 of the gestalt of 1 operation of this invention.

[0010] the stator 14 of the shape of a ring which has the stator pole 11 of 12 poles where the SR motor 10 of the gestalt of this operation projects toward the inside, the coil 13 with which it is wound around the stator pole 11, and the inner circumference of a stator 14 -- a core [ revolving shaft / 15 ] -- a stator 14 -- receiving -- the same axle and relativity -- it is arranged pivotable and has Rota 16 which has the Rota pole 12 of the stator pole 11 and eight poles which can form a magnetic circuit. A stator 14 and Rota 16 carry out the laminating of the griddle, and constitute it.

[0011] The Rota pole 12 which is the meaning of this invention is explained. include-angle theta The Rota pole 12 has shifted to the straight line L2 in which the straight line L1 which connects the core of confrontation section 12a of the Rota pole 12 and the core of fundus 16a of Rota 16 which meet the stator pole 11 goes to the direction outside of a path from the core of confrontation section 12a. Moreover, the stator pole 11 is projected toward the core of Rota, that is, serves as the same configuration as the stator pole of the conventional SR motor shown in drawing 5.

[0012] Although the sequence that a coil 13 generates the magnetic-attraction force can be set up and either an illustration clockwise rotation or a counterclockwise rotation can rotate Rota 16 by this by passing a current in order in each coil 13 with the current control unit which is not illustrated, in the gestalt of this operation, that the running torque of Rota 16 increases is the case where the illustration counterclockwise rotation theta, i.e., an include angle, is the hand of cut and the same direction of Rota 16.

[0013] In such a configuration, if a current flows in a coil 13, the magnetic-attraction force will occur between the Rota pole 12 in Rota 16, and the stator pole 11 of a stator 14. Here, in the part which the Rota pole 12 and the stator pole 11 overlapped in the hoop direction, the magnetic-attraction force works in the direction of a path, and the magnetic circuit which the Rota pole 12 and the stator pole 11 form does not affect rotation of Rota 16. However, in the part which the Rota pole 12 and the stator pole 11 do not overlap in a hoop direction, since the Rota pole 12 and the stator poles 11 tend to overlap mutually, the magnetic-attraction force works to a hoop direction, and thereby, Rota 16 rotates. That is, the running torque of Rota 16 becomes large, so that the magnetic-attraction force committed to a hoop direction is large.

[0014] Drawing 2 is drawing showing the running torque of Rota 16 when changing the straight line L2 which goes to the direction outside of a path, and the include angle theta to make from the core of confrontation section 12a of the Rota pole 12 in drawing 1. By drawing 2, when the component of the hoop direction of a gap and the hand of cut in Rota 16 by the include angle theta are the same direction that is, data in case the hand of cut in Rota 16 is the counterclockwise rotation of drawing 1 are shown. According to drawing 2, in 0 to 45 degrees which is the analytical range of the include angle theta in the gestalt of this operation, it turns out that the running torque of Rota 16 becomes large, so that an include angle theta is enlarged.

[0015] Drawing in which drawing 3 shows the SR motor 20 of the gestalt of operation of the 2nd of this invention, and drawing 4 are drawings showing the SR motor 30 of the gestalt of operation of the 3rd of this invention. Since the gestalt of the 2nd and the 3rd operation is the same configuration as the SR motor 10 shown in drawing 1 except the configuration of the Rota pole by showing the case where the configuration of the Rota pole is changed, to the SR motor 10 of drawing 1, explanation is omitted.

[0016] When the magnitude of the current which flows in a coil when the gap of a predetermined include angle to the straight line which goes to the direction outside of a path from the core of the confrontation section of the Rota pole is the direction where the hand of cut in Rota is the same according to the gestalt of this operation is the same, the protrusion direction of the conventional Rota pole and a stator pole can increase the running torque of Rota sharply compared with SR motor which is the direction of a path.

Therefore, since running torque of Rota can be enlarged without increasing the number of turns of a coil or enlarging the current which flows in a coil, SR motor in which an output of high torque is possible can be offered.

[0017]

[Effect] As opposed to the straight line in which the straight line which connects the core of the

confrontation section of the Rota pole which meets a stator pole, and the core of the fundus of Rota according to claim 1 goes to the direction outside of a path from the core of the confrontation section the degree of predetermined angle by having made it shift When the component of the hoop direction of this gap and the hand of cut in Rota are the same directions, high torque can be acquired without the running torque of Rota becoming large and increasing the magnetic-attraction force compared with SR motor whose protrusion direction of the conventional Rota pole and a stator pole is the direction of a path.

[0018] According to claim 2, a stator pole is made to project toward the core of Rota, i.e., it is having constituted, as only the Rota side's was shown in claim 1, a stator can increase the running torque of Rota further, it is the same configuration as the conventional SR motor, and can acquire high torque further, without increasing the magnetic-attraction force.

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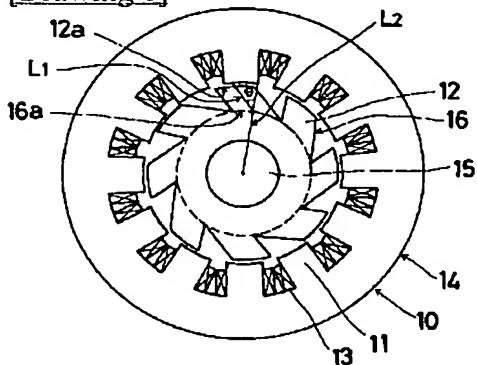
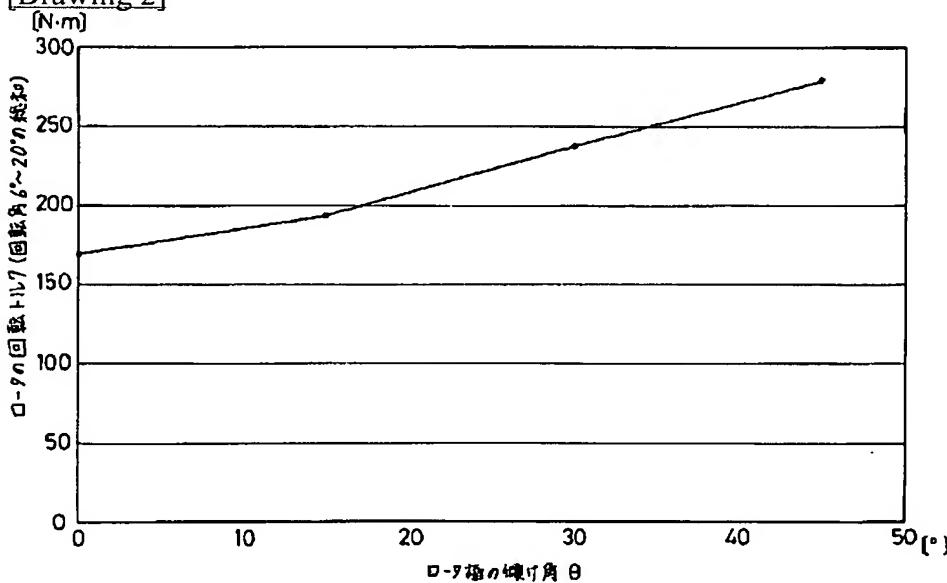
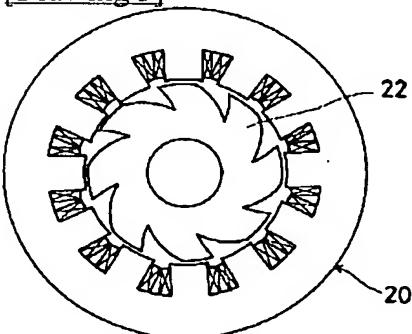
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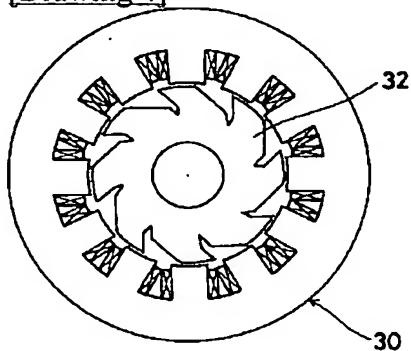
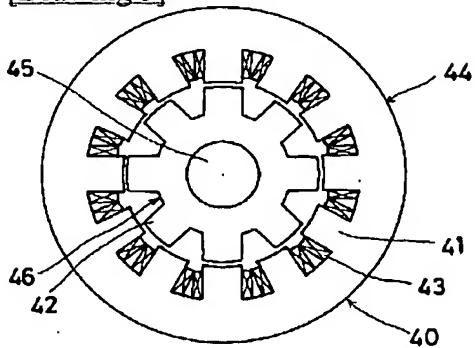
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**DRAWINGS**

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**[Drawing 1]****[Drawing 2]****[Drawing 3]**

[Drawing 4][Drawing 5]

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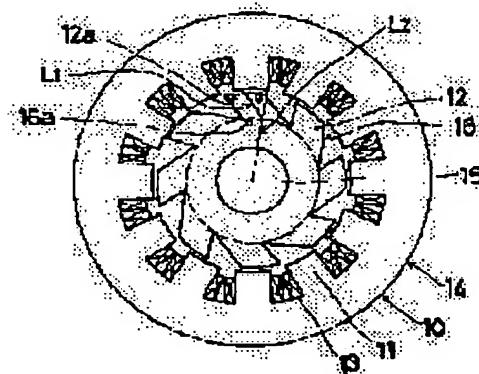
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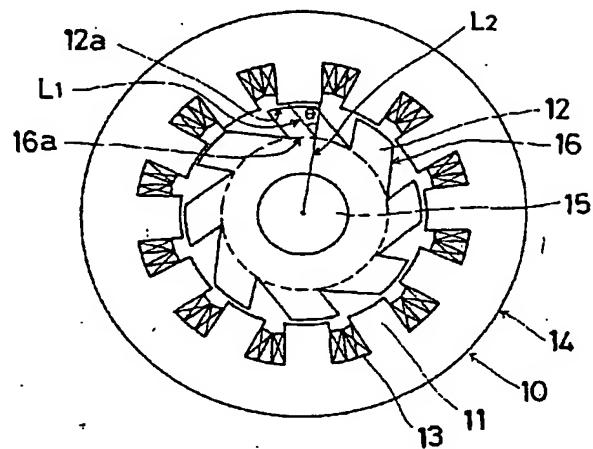
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(54) 【発明の名称】スイッチドリラクタンスマータ

(57) 【要約】

【課題】 コイルの巻数を増やしたり、コイルに流す電流を大きくすることなく、ロータの回転トルクを増大させること。

【解決手段】 内側に向かって突出するステータ極11を有するリング状のステータ14と、ステータ極11に巻回されるコイル13と、ステータ14の内周でステータ14に対して同軸かつ相対回転可能に配設され、ステータ極11と磁気回路を形成可能なロータ極12を有するロータ16とを備え、ロータ極12のステータ極11と対面する対面部12aの中心とロータ16の基底部16aの中心とを結ぶ直線が、対面部12aの中心から径向外側に向かう直線に対して所定角度ずれているスイッチドリラクタンスマータ10。



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【0004】そこで本発明は、コイルの巻数を増やしたり、コイルに流す電流を大きくすることなく、ロータの回転トルクを増大させることを技術的課題とする。

【0005】

【課題を解決するための手段】上記課題を解決するために請求項1は、内側に向かって突出する複数のステータ極を有するリング状のステータと、ステータ極に巻回されるコイルと、ステータの内周でステータに対して同軸かつ相対回転可能に配設され、前記ステータ極と磁気回路を形成可能な複数のロータ極を有するロータと、を備えるスイッチドリラクタンスマータであって、前記ロータ極の前記ステータ極と対面する対面部の中心と前記ロータの基底部の中心とを結ぶ直線が、前記対面部の中心から径方向外側に向かう直線に対して所定角度ずれしていることを特徴とするスイッチドリラクタンスマータ。

【請求項2】 請求項1のスイッチドリラクタンスマータにおいて、前記ステータ極は前記ロータの中心に向かって突出していることを特徴とするスイッチドリラクタンスマータ。

## 【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、電気自動車の動力源等に使用されるスイッチドリラクタンスマータに関するものであり、特にモータの回転トルクに関するものである。

【0002】

【従来の技術】従来より、電気自動車の動力源として、スイッチドリラクタンスマータが用いられていることが知られている。従来より知られるスイッチドリラクタンスマータ40(以下、SRモータと称する)の一例を図5に示す。SRモータ40は円周状に配置されコイル43が巻かれたステータ極41を有するリング状のステータ44と、ステータ44の内側に回転軸45を中心に回転可能に配置され、ステータ極41に対向するロータ極42を有するロータ46とを備えている。SRモータ40はステータ極41を12極、ロータ極42を8極備えている。ステータ極41及びロータ極42はロータ46の中心に向かって径方向にそれぞれ突出しており、コイル43に電流が流れると、ステータ極41が磁気吸引力を発生して、最も近い位置にあるロータ極42がステータ極41に吸引されることでロータ46が回転運動する。

【0003】

【本発明が解決しようとする課題】しかし、上記従来のSRモータでは、ステータ極41及びロータ極42はロータの中心に向かって径方向にそれぞれ突出しているので、径方向に働く磁気吸引力に対してロータ46の回転方向に働く磁気吸引力が小さい。したがってコイル43から発生される磁気吸引力に対してロータ46の回転トルクを有効に得ることが出来ず、ロータの回転トルクを大きくしようとコイルの巻数を増やしたり、コイルに流す電流を大きくすると、磁気吸引力の径方向成分も増大し騒音も増大してしまう、という問題があった。

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【0006】請求項1によると、ステータ極と対面するロータ極の対面部の中心と、ロータの基底部の中心とを結ぶ直線が、対面部の中心から径方向外側に向かう直線に対して所定角度ずれるようにしたことで、このずれの周方向の成分とロータの回転方向が同じ方向の場合は、従来のロータ極とステータ極の突出方向が径方向であるSRモータに比べてロータの回転トルクが大きくなり、磁気吸引力を増大させることなく高トルクを得ることができる。

【0007】請求項2は、請求項1のスイッチドリラクタンスマータにおいて、ステータ極はロータの中心に向かって突出しているようにした。

【0008】請求項2によると、ステータ極をロータの中心に向かって突出させる、つまりステータは従来のSRモータと同じ形状で、ロータ側のみを請求項1に示す如く構成することで、ロータの回転トルクを更に増大することができ、磁気吸引力を増大させることなく更に高トルクを得ることができる。

【0009】

【実施の形態】以下、図面を参照して本発明の実施の形態を説明する。図1は本発明の一実施の形態のSRモータ10の断面図である。

【0010】本実施の形態のSRモータ10は、内側に向かって突出する12極のステータ極11を有するリング状のステータ14と、ステータ極11に巻回されるコイル13と、ステータ14の内周で回転軸15を中心にステータ14に対して同軸かつ相対回転可能に配置され、ステータ極11と磁気回路を形成可能な8極のロータ極12を有するロータ16と、を備える。ステータ14、ロータ16は鉄板を積層して構成している。

【0011】本発明の趣旨であるロータ極12について説明する。ロータ極12は、ステータ極11と対面するロータ極12の対面部12aの中心とロータ16の基底部16aの中心とを結ぶ直線L1が、対面部12aの中心から径方向外側に向かう直線L2に対して角度θずれている。また、ステータ極11はロータの中心に向かっ

て突出している、つまり図5に示す従来のSRモータのステータ極と同じ形状となっている。

【0012】図示しない電流制御装置により各コイル13に順番に電流を流すことで、コイル13が磁気吸引力を発生する順番を設定でき、これによってロータ16を図示時計回り或いは反時計回りのどちらにも回転させることができると、本実施の形態において、ロータ16の回転トルクが増大するのは図示反時計回り、つまり角度θがロータ16の回転方向と同じ向きの場合である。

【0013】このような構成において、コイル13に電流が流れるとロータ16のロータ極12とステータ14のステータ極11との間に磁気吸引力が発生する。ここで、ロータ極12とステータ極11とが形成する磁気回路は、ロータ極12とステータ極11とが周方向において重なり合った部分では径方向に磁気吸引力が働くことで、ロータ16の回転には影響しない。しかし、ロータ極12とステータ極11とが周方向において重なり合っていない部分ではロータ極12とステータ極11とが互いに重なり合うために周方向に磁気吸引力が働くことで、これによりロータ16が回転する。つまり、周方向に働く磁気吸引力が大きい程、ロータ16の回転トルクは大きくなる。

【0014】図2は、図1におけるロータ極12の、対面部12aの中心から径方向外側に向かう直線L2をなす角度θを変化させたときのロータ16の回転トルクを示す図である。図2では、角度θによるずれの周方向の成分とロータ16の回転方向が同じ方向の場合、つまりロータ16の回転方向が図1の反時計回りの場合のデータを示している。図2によると、本実施の形態における角度θの解析範囲である0°から45°の範囲では、角度θを大きくする程、ロータ16の回転トルクが大きくなることがわかる。

【0015】図3は本発明の第2の実施の形態のSRモータ20を示す図、図4は本発明の第3の実施の形態のSRモータ30を示す図である。第2及び第3の実施の形態は、図1のSRモータ10に対して、ロータ極の形状を変化させた場合を示しており、ロータ極の形状以外は図1に示すSRモータ10と同じ構成であるので、説明は省略する。

【0016】本実施の形態によると、ロータ極の対面部の中心から径方向外側に向かう直線に対する所定角度の

ずれがロータの回転方向が同じ方向の場合には、コイルに流れる電流の大きさが同じ場合において、従来のロータ極とステータ極の突出方向が径方向であるSRモータに比べてロータの回転トルクを大幅に増大することができる。したがって、コイルの巻数を増やしたり、コイルに流れる電流を大きくすることなくロータの回転トルクを大きくできるので、高トルクを出力可能なSRモータを提供することができる。

#### 【0017】

【効果】請求項1によると、ステータ極と対面するロータ極の対面部の中心と、ロータの基底部の中心とを結ぶ直線が、対面部の中心から径方向外側に向かう直線に対して所定角度ずれるようにしたことで、このずれの周方向の成分とロータの回転方向が同じ方向の場合には、従来のロータ極とステータ極の突出方向が径方向であるSRモータに比べてロータの回転トルクが大きくなり、磁気吸引力を増大させることなく高トルクを得ることができる。

【0018】請求項2によると、ステータ極をロータの中心に向かって突出させる、つまりステータは従来のSRモータと同じ形状で、ロータ側のみを請求項1に示す如く構成したことで、ロータの回転トルクを更に増大することができ、磁気吸引力を増大させることなく更に高トルクを得ることができる。

#### 【図面の簡単な説明】

【図1】本実施の形態のSRモータを示す図である。  
【図2】角度θとロータの回転トルクの関係を示す図である。

【図3】本発明の第2の実施の形態のSRモータを示す図である。

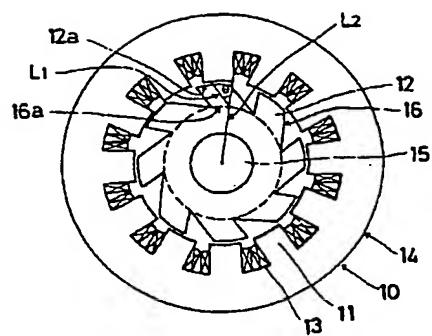
【図4】本発明の第3の実施の形態のSRモータを示す図である。

【図5】従来のSRモータを示す図である。

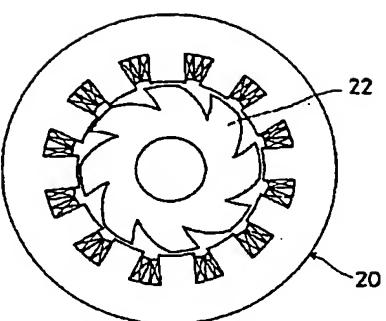
#### 【符号の説明】

- 10、20、30……スイッチドリラクタンスマータ
- 11……ステータ極
- 12……ロータ極
- 13……コイル
- 14……ステータ
- 15……回転軸
- 16……ロータ

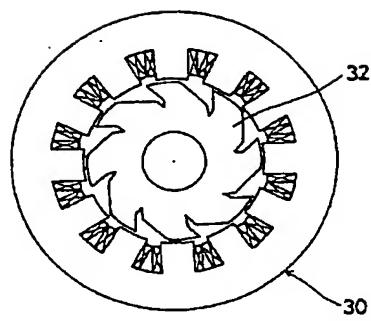
【図1】



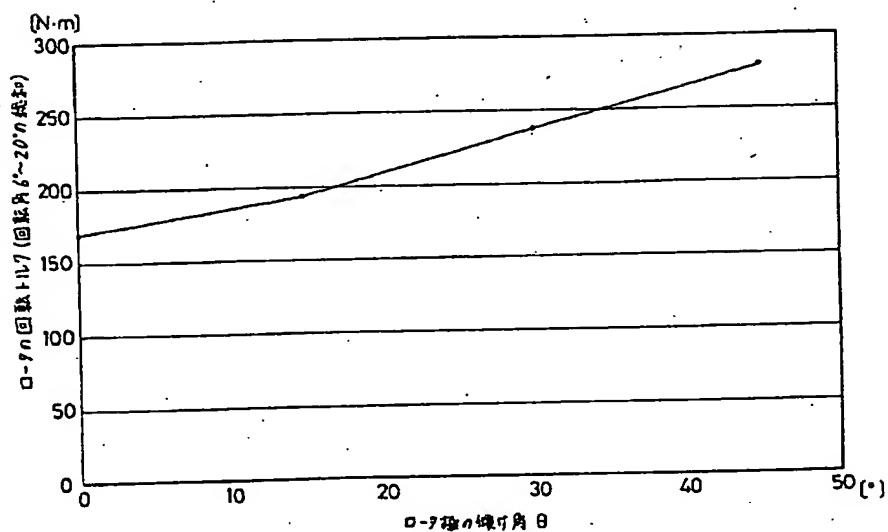
【図3】



【図4】



【図2】



【図5】

